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ERECTING BLAST FURNACES WITH A MAST CRANE

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Mechanization of vertical transport is the main condition for progress in rapid erection of modern 60-meter blast furnaces. Mechanization of vertical transport in Soviet blast furnace construction has been accomplished with various devices. The most effective, however, have proved to be the tower crane, the guy derrick mounted on a triangular base, and the mast crane mounted on a crib footing.

The tower crane, the chief advantage of which is its not requiring guy ropes, has the following disadvantages: (a) its complicated construction and high cost; (b) the complexity and time element (30 - 40 days) of assembling the crane; and (c) the considerable weight (180 - 240 tons) and large dimensions of the crane (from 7.5 by 7.5 meters to 10.5 by 10.5 meters), which make for difficulty of maneuverability along the front of the furnace.

The guy derrick, mounted on a triangular base, has the following disadvantages: (a) the complexity and time element (30 - 35 days) of assembling the base and crane; (b) the complexity of dismantling the crane; the inevitable damage to the base, which, being of triangular construction, cuts across the working platform of the blast furnace foundation and thus also interferes with the construction work; (c) the considerable weight of the base (60 - 70 tons) which is 2 - 3.5 times the weight of the crane; and (d) the necessity of constructing concrete footings for the base and secure anchors for the guy ropes.

The mast crane on a crib footing likewise has its disadvantages; (a) the necessity of constructing anchors for the guy ropes; (b) the need of dismantling the crane when moving it; and (c) removal of the crib footing so that construction work on the working platform of the furnace and casting beds can be carried out.

A new model of the mast crane, strengthened by a truss and resting directly on the ground outside the perimeter of the blast furnace foundation, fulfills the requirements of blast furnace erection and does not have some of the disadvantages

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of the cranes mentioned above. The crane permits rotation of the jib through 360 degrees, lifting the jib through 90 degrees, lifting of a load 70 meters and maneuverability along the front of the furnace. It is unique for its size and load-lifting capacity and is ideally suited for blast furnace erection.

The mast crane, strengthened by a truss, has the following advantages, due to its simplicity:

a. The crane can be set up under field conditions by the construction organization's forces.

b. Introduction of the truss (weighing 7 tons) for strengthening the mast permits dispensing with the complicated and heavy base (weighing 60 tons) and the five concrete footings under the base. This in itself makes construction and erection work on the blast furnace easier, since the space formerly occupied by the base is free.

c. Special construction of the mast in two or three pieces permits assembly of the crane in 8 - 10 days.

d. The small dimensions of the crane permit its erection in the limited confines of the blast furnace area.

e. The absence of a special concrete footing permits moving the crane along the front of the furnace without dismantling it.

As planned, the mast crane has the following: a sectional, riveted mast which is strengthened by a truss and is equipped with a turning plate and jib; jib and load-hoisting tackle; guy wires with tightening device; three single-drum electric winches; a 35-kilowatt motor for the jib and hoisting tackle and a 3.7-kilowatt motor for the winch. The winch drums have a capacity of 500 - 600 meters of cable.

The 75-meter mast of the crane consists of two parts. The lower part is 30 meters long and the upper part 45 meters long. They are connected with a joint for attaching the jib to the mast.

The cross section of the mast is a square, 1,800 by 1,800 millimeters, formed by four angle irons 200 by 200 by 20. The latticework is triangular, formed by angle irons 80 by 80 by 10. The mast is made up of eight sections. The six middle sections are prismatic, their cross sections constant; the upper and lower sections are pyramidal, their cross sections ranging from 1,800 by 1,800 to 500 by 500 millimeters. The section joints are overlapped with laminated sheet and joined the bolts. Lateral rigidity of the mast is assured by cross pieces.

The spherical lower supporting joint of the mast rests on a metal seat, to which the pulleys for the ropes of the jib and load-hoisting tackle are fastened on a horizontal shaft. The seat is intended to support the weight of the mast on the ground without building a footing and to make possible movement of the crane along the front of the blast furnace on rails. The cylindrical upper supporting joint consists of a vertical shaft securely fastened to the mast and of a horizontal disc with bronze bushing and openings for fastening the guy ropes.

The truss is made of inclined flanges and a 5-meter brace, located at the point where the jib is fastened to the mast. The truss flanges are formed by two angle irons 150 by 150 by 16, spaced 500 millilmeters apart. The brace is formed by four angle irons 150 by 12. To add rigidity to the truss when the crane is rotated, additional braces have been added. These are located at the assembly joints of the mast.

The turning plate, 3 meters in diameter, is made of No 18 channel iron and consists of two halves fastened to the mast with bolts.

The jib, 40 meters long over-all, consists of four sections. The middle section, of square cross section 1,200 by 1,200 millimeters, are formed by four angle irons 120 by 120 by 10; the end sections are of varying cross section. The latticework is triangular with additional braces. Rigidity is assured by means of cross pieces. The sections of the jib are joined with laminated sheet and bolts.

The jib-hoisting tackle is made up of seven reducer turns of cable 28 millimeters in diameter or 11 reducer turns of cable 25 millimeters in diameter and of 2-, 3-, or 5-sheave pulley blocks. Diameter of the sheaves is 600 - 700 millimetes. The load-hoisting tackle is made up of seven reducer turns of cable 25 millimeters in diameter and of 2- or 3-sheave pulley blocks, one of them equipped with a hook. Diameter of the blocks is 600 millimeters

Six guy wires, 42 - 48 millimeters in diameter, hold the crane in vertical position during its operation. Each guy wire is fastened at one end to the top of the mast, at the other end to a permanent or temporary anchor. Tightening of the guy wires before fastening to their anchors is carried out with 3-ton winches and pulley blocks with four or five reducer turns of cable, 22 millimeters in diameter. Guy wire anchors are of concrete construction with metal hook-on devices.

The crane is produced in two models, MD-30 and MD-45. On the former model, the jib is located 30 meters above the spherical joint. Lifting capacity of this crane is 20 tons with the jib extending 40 meters and 40 tons with it extending 15 meters. The working radius of the crane is 40 meters. On the MD-45 model, the jib is located 45 meters above the spherical joint. Lifting capacity of this crane is 25 tons with the jib extending 30 meters and 40 tons with it extending 15 meters. Working radius of the crane is 30 meters.

The advantage of Model MD-45 over MD-30 consists in the greater facility of erecting a blast furnace, however, loss of jib reach reduces the working radius of the crane. Both models are entirely satisfactory for blast furnace erection and with improvement will replace the costly and cumbersome blast furnace crane.

A blast furnace was to be erected with a Model MD-45 crane. Setting up of the crane was accomplished as follows: the 75-meter-long mast was assembled on the ground on blocks 0.5 meters high. Then, two 50-meter-high masts equipped with block and tackle were put up. With the aid of two electric winches, the mast was raised into vertical position and fastened down with guy ropes. After this, the seat was put down and the spherical joint assembled. With the aid of auxiliary block and tackle attached to the mast top, the jib was raised and installed at the joint at the 47-meter mark. Then, the jib and load-hoisting tackle were installed, and the crane was in condition for use. Finally, using this crane, the two erection masts were taken down.

The new Model MD-45 mast crane has been tested for blast furnace erection.

The considerable lifting capacity and working radius of the crane permits erection of the shells of Cowper furnaces, of the cupolas of Cowper furnaces in completely assembled form, and of furnace shells, hearths, and boshes.

The moratornoye /?/ ring of a shaft furnace shell weighing 26 tons was installed in completely assembled form for the first time in construction practice. Usually, the moratornoye ring is installed in four pieces.

The shell of a shaft furnace was erected for the first time in one piece. This accomplishment has no precedent in blast furnace construction.

A blast furnace installation was erected from ten parts: the deflector part of the gas uptakes in four lifts; the gas uptakes with lining plates attached in two lifts; the drop hammer in completely assembled form in one lift; the assembly beam in one lift; platforms under the charging apparatus and air valves in two lifts. The inclined bridge was erected from three parts. The inclined gas uptakes were installed in completely assembled form. The shell of the dust catchers was installed from three parts.

Use of the mast crane in blast furnace erection has a considerable economic importance. According to figures of experts of the Ministry of Construction of Heavy Industrial Enterprises, total cost of the mast crane is half that of the blast furnace crane. Annual saving of operating expense amounts to about 60,000 rubles.

Erection of industrial installations with cranes of adequate lifting capacity and working radius reduces the construction period by half to two thirds.

The mast crane can be used successfully for the erection of modern open-hearth furnaces and similar high installations.

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